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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
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Technical News Bulletin No. 89.

September 10, 1924.

GENERAL NOTE

Owing to the current nature of the investigations mentioned in the Technical News Bulletin, sometimes it will be impossible to supply printed information regarding them. However, in these cases, when the investigation has progressed sufficiently far, the Bureau will be pleased to furnish technical data to those engaged in the particular application of the subject, in order to avoid the delay incident to publication.

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1 Hardened Copper.

Since the recent newspaper story of the wonderful discovery of "the lost art of hardening copper" by an automobile mechanic and the immediate sale of the "secret" for an unbelievable sum (cash in hand), the Bureau has received numerous inquiries concerning this and similar process. From a set of samples submitted by one party, undoubtedly prompted by the newspaper story referred to a typical piece was selected for examination as an example of the line along which such "inventors" work.

The chemical analysis showed the following results:

Copper - - - - - - - -	91.7 per cent
Aluminum - - - - - - -	7.8
Manganese - - - - - -	0.26
Lead - - - - - - - - -	0.10
Iron - less than - -	0.10

It is evident from this that the "hardened copper" was merely an aluminum bronze - an alloy known for a good many years and having considerable use at present. In addition the attempt had been made to "stiffen" and harden the material by rolling. The result, however, was decidedly inferior to what would be considered even fair commercial practice.

In general it may be said that present day metallurgists are quite familiar with the general means which may be used in hardening copper or other metals. Essentially they are chemical in nature (alloying additions) or physical (cold working) or combinations of these two methods.

2 Quenching Media for Heat Treatment.

During the past month a report was completed which covers the first phase of the investigation of quenching media for heat treatment. It relates to "quenching diagrams" for carbon steels, in which are shown the relations between Rockwell hardness, microstructure, thermal transformations and the cooling velocity at 720°C. A discussion is given of the general relations between these quenching diagrams and various coolants such as water at different temperatures, oils, sulphuric acid solutions of various concentrations, brines and sodium hydroxide solutions. The report was released for publication and will be presented in Boston, Mass. during the annual meeting of the American Society for Steel Treating in September.

3 Study of the Density of Ferrous Alloys.

Numerous requests have recently been received for the density values of carbon and alloy steels in varying conditions of work and thermal treatments and show the need for much more information than is now generally available. Accordingly plans were made to study the effects of composition, mechanical and thermal treatments upon the density of iron and steel. A large number of specimens suitable for density determinations are now available and these will first be assembled; subsequently additional material will be secured to fill any gaps which may exist. Laboratory work should begin during the coming month.

4 Heat Radiation and Temperature of Mars.

The measurement of heat radiations from Mars being made at Lowell Observatory has been extended by means of various screens and their intensities measured. Previous observations showing that the radiation from Jupiter and Saturn, transmitted by our atmosphere, is relatively much less intense than that from Mars and the Moon, have also been verified.

It is calculated that the temperature of a complete radiator which would give a radiation similar in quality and intensity to that of Mars is much higher than previously calculated. This may be due to (1) lack of knowledge of the coefficients of transmission of our atmosphere; (2) a highly selective emission of the planet, and (3) a higher planetary temperature than here-to-fore supposed.

Extensive measurements of the terrestrial radiation from mountain peaks, mountain slopes covered with vegetation and sea level stations are in progress. These results will, no doubt, be useful in interpreting the measurements of planetary radiation.

Some interesting points shown by observations are: Mars is at a higher temperature than the thermopile receiver; the morning side of Mars is cooler than the evening side; and it is at temperature of 15 to 20°C or higher.

5 X-rays for Locating Concrete Reinforcement.

An interesting possible commercial application of x-ray was suggested in a conference with a consulting engineer, namely that of locating steel reinforcement rods in concrete girders in buildings already constructed, and thus avoid mutilating the structure. The practical difficulty is that very powerful x-ray equipment would be required to penetrate large girders.

6 Thin Celluloid Films.

The experiments on thin films have been continued. Films of celluloid 3 millimicrons (one ten-millionth of an inch) thick have been made. The announcements by the press of these experiments have resulted in a number of inquiries in regard to the method of making them and possible applications in the industries. Experiments to determine the gas pressure which these films will stand are now being carried out.

7 The Preparation of Levulose.

The research on the preparation of crystalline levulose has been brought to completion and the manuscript describing the experiments is in preparation. Levulose is the sweetest and one of the most nutritious members of the sugar group. It has therefore the intrinsic qualifications of a staple commodity for ordinary commerce. On account of the great difficulties encountered in its preparation it has hitherto been one of the most expensive of the sugars, selling for $30. to $110. a pound, according to the source from which it is prepared.

As a result of the Bureau's research, a method has been devised by which it is feasible to prepare the sugar from dahlias or Jerusalem artichokes at a relatively very low expense. The latter plant serves as a particularly promising source since it is extremely prolific and its agricultural requirements are very simple. The process of preparation from artichokes consists of juice extraction, conversion and clarification, precipitation of the sugar with lime, and crystallization from aqueous solution. Each of these steps, simply accomplished under the procedure finally determined, has involved an extensive study amounting in the aggregate to several years. The resulting product is a brilliantly crystalline material of high solubility, somewhat less stable in humid atmosphere than cane sugar, but of great sweetness and palatability. It

is estimated that from 80 to 85 per cent of the levulose in the extracted juice may be recovered as crystalline sugar.

8 Street Lighting.

A paper entitled "A survey of street lighting practice in the United States" has been prepared for presentation at the annual Convention of the Illuminating Engineering Society. This paper gives data on the cost of street lighting per capita and per mile, and the average levels of illumination in cities of different sizes.

9 Electric Strain Gage for Use in Study of Mass Concrete.

In cooperation with Engineering Foundation, the design of a carbon resistor cartridge for measuring deformation in mass concrete has been undertaken, with particular reference to the study of arch dams. A design has been completed and an experimental cartridge made up which is now being given a series of laboratory trials to determine temperature and other effects. It is planned to make up a number of these cartridges and embed them in concrete with a view of determining the effects of shrinkage and other factors as an aid to interpreting results obtained in field work.

10 Airplane Batteries.

The work of determining the temperature coefficient and capacity of airplane batteries has been resumed. A number of discharges on thin plate batteries have been made in a refrigerating box at temperatures of freezing and below. These tests have developed certain unexpected difficulties arising from the behavior of the negative plates. It has been found that in a battery of which the positive plates limit the capacity at ordinary temperatures, these same batteries when subjected to low temperatures are deficient in capacity at the negative plates. The curve relating temperature and capacity therefore does not have the usual form, and it appears necessary to make experiments to determine the temperature coefficient of the positive plates and negative plates separately. The importance of this work arises from the fact that these airplane batteries are subjected to extremely low temperatures at high altitudes where it is important that they should function satisfactorily. A special experimental cell has been devised to be used in these experiments.

11 Submarine Cable Investigation.

A large number of specimens of cable insulation have been prepared from rubber compounds which are expected to show good aging characteristics. Parallel tests are being made on these specimens of their physical properties, electrical constants, and performance as diaphragms in aero-

nautic instruments. Some of the specimens for the last mentioned tests have been made in the form of very thin, molded sheets.

12 Permeability of Stone from Boulder Canyon Dam Site.

Preliminary determinations of the permeability of stone samples from the Boulder Canyon Dam project have been made under 300 pounds pressure. The amount of water which passed through a sample of granite 1/2 inch thick in 10 hours at this pressure was almost negligible. A volcanic breccia under the same conditions indicated a slightly greater permeability. The apparatus used for these tests was designed especially for testing materials under high pressures for the Reclamation Service in connection with the proposed Boulder Canyon Dam.

13 Investigation of Physical Properties of Building Stone.

Disintegration of Stone from Efflorescence.- In studying the weathering qualities of natural stone under actual conditions of use, frequent examples have been noted where disintegration occurred on comparatively new buildings of limestone, sandstone and even granite. Such cases could not be attributed to the action of frost or the usual destructive agencies of the weather because under ordinary conditions the stone should not show signs of decay sooner than 40 or 50 years. These cases could nearly always be attributed to the formation of efflorescence due to the leaching of water through the parts of the masonry. About a year ago a series of tests was started at the Bureau of Standards to determine how severe the effect of efflorescence is on masonry. Twelve limestone panels which had been previously constructed for another test were utilized for this purpose. Blocks of stone with cup-shaped holes in the top were placed on the panels to catch the rain water and cause an excessive amount of leaching through the stone work below. In a short time considerable efflorescence formed where the water leached through to the surface of the stone and within a year, decay of the stone at these places was noted.

These experiments were contrived to accelerate the action which actually occurs in buildings where the rain water is allowed to penetrate the masonry in excessive amounts as through window sills, the cornice or coping and brings the water-soluble matter to the surface. The crystallization of the dissolved matter in the pores of the stone during the drying process causes decay similar to that due to frost, but much more rapidly.

14 Fire Tests of Roofing Materials.

Flame tests have been conducted on wood shingles from a number of species, laid on open and on closed board decks. In some of the tests the brands from the burning deck were allowed to fall on another larger shingle deck. No fire on this deck resulted. It was built of red cedar shingles laid on open board decks. Measurement of the brand hazard by this means was therefore abandoned, and the brands developed in all flame tests will be caught in the brand collector. The latter has been improved so that it now retains all but a small percentage of the brands given off. Carbon dioxide gas has been substituted for carbon tetrachloride as an extinguishing agent for the brands.

15 Brake lining Temperature and Deceleration Tests.

A 4-wheel brake car, equipped with thermocouples in all brakes, was run at several temperatures of brake linings to determine the effect of temperature on deceleration. These tests have been made on several types of brake linings and the effect of increase of temperature of the linings, in each case, has been to decrease the coefficient of friction. Curves have been plotted showing this effect.

16 Brake Performance Tests.

On July 30 and 31 tests were made in Washington on about 180 cars to determine the general braking ability of the average car on the road. The average stopping distance from 20 miles per hour for service brakes was found to be about 45 feet, and for hand brakes about 78 feet.

Arrangements were entered into with the Deputy Commissioner of Motor Vehicles for the State of Maryland, to test cars, the drivers of which were applying for driving licenses. On August 12 and 13 these tests were made in Baltimore. About fifty cars were tested. The general average for service brakes was found to be about 44 feet and for hand brakes about 65 feet.

17 Measurement of Delay in Applying Auto Brakes.

In connection with the study which the Bureau has made of brakes and braking systems, measurements have been made of the time elapsing between the instant when a car driver is told to stop and the instant when the car actually begins to slow down due to the action of the brakes. This time interval was measured with 9 different drivers and its average value was found to be about 1/2 second. A part of this time interval is due to what may be termed the reaction time of the car operator, that is the time elapsing between the instant when the command to stop is given and the instant when the operator makes the first of the series of motions necessary to the braking of the car. The remainder of the time interval is consumed in the making of

these motions, that is to say in moving the foot from the accelerator to the brake pedal, in moving the pedal sufficiently to take up the lost motion in the braking system, etc.

The importance of keeping this time interval as small as possible will be evident when it is realized that a car travelling at 30 miles per hour will go 22 feet in that time. Many four wheel brake cars can be brought to a stop from that speed in a distance of 45 feet. This factor becomes more important as the effectiveness of brakes is increased since the distance travelled by the car between the time when the car begins to slow down under the action of the brakes forms a greater proportion of the total distance travelled before the car is actually brought to a stop.

18 Horological Institute.

A meeting of the Examining Board of the Horological Institute of America was held on August 19 at Boston, Mass. Watches and papers were forwarded to the Board for examination. 9 certificates for Certified Watchmakers and 34 certificates for Junior Watchmakers were issued.

19 Investigation on Stop-Watches.

The investigation on the durability of stopwatches is progressing very satisfactorily. Of the twenty-seven original watches, eight are still in working order after 16,000 punches from the apparatus built in the shop. A study of the stopwatches in use at the Bureau is being undertaken in connection with this investigation.

20 New Method for Measuring Electrolytic Potentials.

Electrolytic potentials are of importance in the study of electrochemical processes. A paper describing a new method of measuring electrolytic potentials and polarization has been completed. This is to be published shortly. The method described employs an electron tube amplifier with resistance coupling. The electrolytic cell which is to be studied is put in series with the battery of the grid circuit and the potentials in this circuit are measured by an oscillograph which is operated by the plate current of the amplifying tube. It has been found possible to distinguish between the true electrolytic potential and the potential drop which is caused by ohmic resistance. It has also been found possible to study the so-called transfer resistance which is found at the surface of the contact between the metallic electrode and the electrolyte. This transfer resistance appears to be a fairly definite quantity for certain electrodes but is not found at all in others. Polarization measurements can be made with accuracy. The paper is limited to a description of the

method and its use in the case of some typical electrodes including both smooth and platinized platinum, carbon, lead, and copper in sulphuric acid and copper in a copper sulphate solution.

21 Testing of Meggers.

For the testing of insulation of electrical apparatus, a direct-reading ohmmeter known as a "megger" is extensively used. These instruments are made in various measurement ranges, the highest listed range having an upper limit of 10,000 megohms; that is, 10,000,000,000 ohms. No laboratory has resistance standards aggregating this amount, so that a direct check of a megger over its scale is usually impossible.

Following a published suggestion from Professor R. E. Brown, of the University of Pennsylvania, concerning an indirect method by which a megger may be checked against resistance standards of an aggregate value, much less than the maximum value shown on its scale, the Bureau made tests to determine the practical limitations of the method. A paper on the subject, giving schedules of tests for three meggers of differing ranges and characteristics has been prepared with a view to its publication at an early date.

22 Tests of Waterproofed Paper Board.

In connection with testing the water resistance of waterproofed papers such as caselining, a method was devised which consisted of folding the paper box-shape, filling with water, placing on a piece of ground-glass which is laid over a black surface, and noting time of water transudation as indicated by appearance of a film of moisture on the ground glass. There is a demand for such a test as regards waterproofed paper board. A modification of the above method was devised which consists in securing the specimen to the bottom of a glass cylinder with paraffin and filling the cylinder with water. Tests of a number of paper board samples waterproofed with asphaltum showed that satisfactory results can be secured in this manner.

23 Size Testing of Paper bythe Cure Method.

In relation to testing the degree of sizing of paper a report is being prepared which will contain a description of the "Curl Size Tester", this instrument having been devised for application of the "Curl" method of testing. A discussion of results obtained with this method in comparison with other proposed methods will be included. A "Curl Size Tester" has been sent to a paper mill laboratory which will make a study of the "Curl" method as applied to control of sizing in manufacturing processes.

PUBLICATIONS OF THE BUREAU OF STANDARDS RELEASED DURING AUGUST

Scientific Papers

S 490 Spectra and critical potentials of fifth group elements. . . Arthur E. Ruark, F. L. Mohler, P. D. Foote and R. L. Chenault 10¢

S 491 Theory of determination of ultra-radio frequencies by standing waves on wires. . . . . .August Hund 15¢

Circulars

C 100 Nickel and its alloys. (2nd edition) 40¢
C 154 National Standard petroleum oil tables. 30¢
C 165 United States Government master specification for olive drab paint (semipaste and ready-mixed). 5¢
C 167 United States Government master specification for tent duck (special construction for bleaching or dyeing), grey. 5¢
C 170 United States Government master specification for the construction of built-up roofing, type 4AWS. 5¢
C 171 United States Government master specification for the construction of built-up roofing, type 5AWS. 5¢
C 172 United States Government master specification for the construction of built-up roofing, type 3ACS. 5¢
C 173 United States Government master specification for the construction of built-up roofing, type 4ACS. 5¢
C 174 United States Government master specification for the construction of built-up roofing, type 5ACS. 5¢
C 175 United States Government master specification for the construction of built-up roofing, type 3TCS. 5¢
C 176 United States Government master specification for the construction of built-up roofing, type 4TCS. 5¢
C 177 United States Government master specification for the construction of built-up roofing, type 5TCS. 5¢
C 178 United States Government master specification for the construction of built-up roofing, type 4TWS. 5¢
C 179 United States Government master specification for the construction of built-up roofing, type 5TWS. 5¢
C 180 United States Government master specification for the installation of metal flashings with built-up bituminous roofing. 5¢
C181 United States Government master specification for the installation of plastic flashings with built-up bituminous roofing. 5¢

Handbooks

H 5 American Logging and Sawmill Safety Code. 60¢

These publications can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices indicated above.

Respectfully,

George K. Burgess, Director.

HGB.